TRANSMISSION MECHANISM COMPRISING A SHIFTING DEVICE

The invention relates to a transmission system with a shift mechanism for controlling the transmission system, a control device for controlling a transmission system with a shift mechanism, a method for controlling such a transmission system or shift mechanism, as well as an application for the transmission system.

In order to shift various gears in a transmission system, particularly an automated shift transmission, shift mechanisms are used. The shift mechanisms include a shift motor and a selection motor, wherein the motors control a selector finger, which is moved in an arrangement including a selection passageway and various shift passageways. The shift passageways are thereby assigned to predetermined gears, so that within the shift passageway there exists one position in which a predetermined gear of the transmission is fully engaged. Through an appropriate mechanism with shift forks, the movement of the selector finger is transmitted to gearshift rings. A selector shaft that is coupled with the selector finger is controlled by the motors in such a way that it can execute swiveling movements around its axis as well as axial movements. The swiveling or linear movements are changed into shift movements or movements of the gearshift rings.

Those movements, or especially the movements of the motors, are tracked by passageway and/or angle sensors. They are designed specifically as incremental passageway sensors, hence as sensor devices that detect a position by adding up individual increments along a passageway or an angle.

Such shift mechanisms have proven useful, particularly for controlling automated shift transmissions. The use of incremental displacement detection devices has frequently led to cost savings compared with the use of absolute displacement detection devices.

Nevertheless, it would be desirable to further improve those known transmission systems with shift mechanisms, particularly with regard to their reliability and shifting accuracy.

Particularly when incremental displacement detection devices are used, there is a risk of incorrect shifts, which, apart from a loss of comfort, can cause delayed shift procedures or damage to the transmission or the shift mechanism.

It is therefore desirable to be able to accurately determine or check the current position of the selector finger or to be able to perform a position alignment or position adjustment, even when information from a position-sensing device is lost or inaccurate. Furthermore, it would be desirable for position errors encountered during the detecting or controlling of the selector finger to be detected as quickly and as safely as possible, and replacement measures introduced for their elimination.

A secure adaptation of predetermined positions, such as particularly the final gear positions, at a predetermined point in time would also be desirable.

The invention is therefore based on the object of producing an improved transmission system with a shift mechanism, and a method for controlling the same, along with a control device for controlling the actuation device of the same, which will reduce the probability of incorrect shifts, transmission damage, functional impairment, and failure, and through which the possibility of improved driving comfort is produced.

The object is attained by a transmission system with a shift mechanism in accordance with claim 1 and/or claim 7 and/or claim 8 and/or claim 25 and/or claim 28 and/or claim 29 and/or claim 34 and/or claim 46 and/or claim 50 and/or claim 62 and/or claim 63 and/or claim 66 and/or claim 67 and/or claim 117.

The object is further attained by a control device for controlling the actuating device of a shift mechanism in a transmission system, in accordance with claim 70 and/or claim 116.

A method in accordance with the invention is the subject matter of claim 71 and/or claim 72 and/or claim 75 and/or claim 82 and/or claim 85 and/or claim 96 and/or claim 98 and/or claim 99 and/or claim 102 and/or claim 104 and/or claim 106 and/or claim 111 and/or claim 113 and/or claim 114 and/or claim 115.

An application in accordance with the invention is the subject matter of claim 122 and/or claim 123 and/or claim 124.

Preferred improvements of the invention are the subject matter of the dependent claims.

In accordance with the invention, a transmission system with a shift mechanism for its actuation is proposed, whereby the shift mechanism has an arrangement for automatically determining at least one predetermined parameter, from which, starting from an unknown selector finger position, that is, especially an unknown position within the selection-shift-passageway device, the parameter can be determined.

It should be noted that in all embodiments in this application the transmission system is preferably formed as an automated transmission (ASG) of a motor vehicle. It should further be noted that the embodiments of the invention are explained particularly in reference to a shift mechanism designed to actuate a transmission system, however that should not represent a limitation of the invention of the shift mechanism. The invention also extends particularly to a transmission system having features in accordance with the invention.

The shift mechanism has a selection-shift-passageway device. Within the framework of this application, a selection-shift-passageway device should be particularly understood as an arrangement of at least one selection passageway and at least one shift passageway. In this selection-shift-passageway device or in this shift diagram a first shift element, which is specifically a selector finger, is movable. It should further be noted that within the framework of this application a shift passageway should be understood particularly as a passageway that is arranged in a certain position in the selection direction. In particular, passageway portions that extend on different sides of the selection passageway and are arranged in a specific position in the selection direction are designated as a shift passageway. In particular, those different passageways are also designated as a shift passageway.

It should be noted that the term "selector finger," to which reference is made within the framework of this disclosure, should be understood in a broad sense. In the sense of the claims, the term selector finger should for that reason be understood generally as a shift element.

The selector finger is controlled by an actuating device, which especially has a selection motor and a shift motor. The selector finger is controllable by the selection motor in the selection direction, that is, in the direction that is determined by the

longitudinal direction of the selection passageway. Correspondingly, the selector finger is controllable by the shift motor in the shift direction, that is, in the direction that is determined by the longitudinal direction of the shift passageway.

An actuating device in the sense of this application is especially to be understood to be a device that has at least one motor, especially an electric motor. In particular, the actuating device has a selection motor and a shift motor, whereby those motors control particularly a movement of the selector finger and/or a selector shaft in different directions.

A position sensor detects the selector finger movement or the selector shaft movement or the motor movement, that is, especially the movement of a selection motor and a shift motor.

It should be noted that the term position sensor or passageway measuring device should be understood within the framework of this invention in a broad sense, and includes especially a device for detecting a passageway length and a device for detecting a (traversed) angle and/or a position. Furthermore, this term extends both to an absolute position sensor as well as to an incremental position sensor. The position sensor is preferably formed as an incremental angle sensor, whereby in a particularly preferred embodiment an angle sensor mechanism is arranged on or in the selection motor or in its vicinity, and on or in the shift motor or in its vicinity, respectively. It is also preferred that a selection motor controls an axial movement of a selector shaft, and a shift motor controls a rotational or swiveling movement of the selector shaft, whereby an incremental angle sensor detects the swiveling movement and a passageway sensor for detecting a longitudinal movement of the translatory movement.

A passageway sensor, within the framework of this application, should be understood particularly as a sensor that detects an angular or swiveling movement, or a sensor that detects a translatory motion, or a sensor that detects a displacement distance. The passageway sensor is designed especially as an incremental passageway sensor.

The shift mechanism preferably has a second shift element, that is preferably formed as a selector shaft. It should be noted that for the purpose of simplifying the

explanation of the invention, reference is made in the following to a selector shaft, whereby instead of a selector shaft a differently designed shifting element can also be utilized.

With the device for automatically establishing at least one predetermined parameter of the shift mechanism, that respective parameter can be determined independently from knowledge of the starting position of the selector finger in the selection-shift-passageway device. Hereunder, it is especially to be understood that with this device the determination of the parameter can also be made possible when at the starting point of this determination process no information, or no sufficiently accurate information is available about the current position of the selector finger within the selection-shift-passageway device. In that way, parameters, preferably geometric parameters, can also then be determined when the position sensor produces incorrect or no values as to the current (starting) position of the selector finger.

The detectable transmission parameters can basically be arbitrary, predetermined parameters of the transmission system and/or the shift mechanism and/or a control device for controlling the shift mechanism. In particular, the transmission parameters describe the alignment, the position, the width, or the length of a shift passageway or the selection passageway, or at least the course of the passageway walls. A further example of such a parameter is represented by a predetermined position within the selection-shift-passageway device, whose absolute position is known. In that manner, particularly predetermined coordinates can be assigned to a predetermined point by a reference characteristic, so that when that point is reached, the (relative) position of other points within the selection-shift-passageway device becomes known (again), in accordance with the reference characteristic. The predetermined parameter can particularly also be the position of a (force-free) final gear position within the shift passageways, or the position of the selector finger at an engaged neutral gear. The operability of the position sensor or the actuating device or their motors can also be considered to be a parameter. A further example of such a parameter is represented by the position of a selector shaft. The parameter can particularly be a predetermined point or a distance

measurement, or the identity of a gear stage. It should be noted that this specification of examples of parameters does not limit the parameters that can be considered.

In accordance with an especially preferred embodiment of the invention, in accordance with a predetermined characteristic value a geometric-parameter-determining device moves into a predetermined reference position within the selection-shift-passageway device, whereby the starting position of the selector finger can be unknown. It should be noted that herein movement should be understood that the selector finger is moved into a predetermined position. Starting from that predetermined position, that particularly represents a geometric parameter, in accordance with a second predetermined characteristic value predetermined geometric parameters can be detected or from the selector finger predetermined positions for detecting predetermined geometric parameters can be run.

It should be noted that the starting position in particular can also be estimated. The first characteristic value can particularly be based on the analysis of predetermined parameters, such as especially the movement passageway or the like, which are controlled starting from current positions.

It should be noted that, in accordance with the invention, predetermined parameters are preferably detected, from which corrected values can be generated by addition and/or multiplication and/or other operations, and/or as a function of experimental values, or by other ways, in accordance with a predetermined characteristic value corrected values can be produced that can then be further utilized as transmission geometric parameters. It is also preferred in accordance with the invention that the transmission geometric parameters are determined indirectly.

In accordance with a particularly preferred embodiment of the invention, the selector finger can be controlled and/or moved by the device for establishing predetermined transmission geometric parameters in the selection direction and/or in the shift direction, starting from the unknown selector finger position, so that the existing movement passageways of the shift finger in the selection and/or shift direction near the unknown shift finger position can be determined. Subsequently, the device for detecting predetermined transmission geometric parameters can then

evaluate the results of those possibilities for motion in the shift and/or selection direction. Within the framework of this evaluation it is preferred that additional parameters are consulted. Those additional parameters or data or information are particularly stored in a storage device. The evaluation takes place particularly in accordance with a predetermined evaluation characteristic. Based upon the result of that evaluation and/or other parameters or information that have/has already been determined or are/is known, a predetermined new position for the shift finger is subsequently approached, in accordance with a predetermined characteristic value. In particular, the end point that is to be approached is established whereby the movement toward that position results from detecting by touch and/or in accordance with a predetermined passageway. It is preferred that a new position is controlled iteratively.

The values that have been determined through the respective method or by determining the respective movement passageways are especially directly supplied to an evaluation. It is also preferred that they be processed and/or modified by addition or multiplication operations, or the like, or on the basis of experimental values, corrective values, or the like, before being brought up for further evaluation.

The steps of controlling a position, determining the movement passageway starting from that position, as well as the evaluation of the determined movement passageways, especially to control a new predetermined position, are repeated by the device for detecting the predetermined geometric parameters, preferably so long until the predetermined transmission geometric parameters have been completely detected.

In accordance with a particularly preferred embodiment of the invention, at least one of the neutral gear positions and/or at least one of the synchronous positions and/or at least one passageway position and/or passageway width is included in those transmission geometric parameters.

It is particularly preferred that, at least part of the time, predetermined stops and/or predetermined walls of the selection passageway and/or the shift passageways are started by the transmission geometric parameter detecting device, or a corresponding start is implemented by a method, whereby the passageway wall

and/or the stop are detected indirectly. For indirect detection, various methods can be considered. Particularly, predetermined parameters or operating parameters can be used, or the impact against a passageway wall or on a stop device can be detected based upon the time history. In particular the selection and/or the shift motor can be controlled in such a way that it is supplied with a predetermined velocity (rotational speed), a predetermined acceleration (angular acceleration), a predetermined force (moment), an iterative movement with a predetermined passageway (angular position), a movement with random displacement guideline (angular position), and/or a predetermined voltage and/or a predetermined current, or another predetermined movement, or a combination of the above-mentioned movements when the shift finger can proceed freely. When it strikes a stop device, those values change.

An analysis of the stop can particularly result from the detection and/or the analysis of the sliding sleeve passageway and/or the sliding sleeve velocity and/or the sliding sleeve acceleration and/or a passageway at any random position in the space between the E-motor, thus especially the selection and/or the shift motor, and the shift finger and/or a velocity at a random position in the space between the E-motor and the shift fork and/or an acceleration at a random position in the space between the E-motor and the shift fork and/or a shift force measurement at a random position in the space between the E-motor and the shift fork and/or the angular position of the motor and/or the motor rotational speed and/or the angular acceleration of the motor and/or the motor voltage and/or the motor current and/or a target and the actual value comparison of the position controller and/or the axial position of the transmission shaft and/or the axial velocity of one or several transmission shafts and/or the axial acceleration of one or several transmission shafts and/or the angular position of one or several transmission shafts and/or the angular speed of one or several transmission shafts and/or the angular acceleration of one or several transmission shafts and/or the transmitted torque of one or several transmission shafts and/or the torque transmitted by the transmission and/or a random combination of the above-named values.

The object of the invention is further attained through a transmission system with a shift mechanism in accordance with claim 7.

In accordance with the invention, the shift mechanism is provided with a device for determining and/or checking and/or fine-tuning the neutral position of the transmission. Such a device enables the neutral position to be located. In order to locate that neutral position, the device for determining and/or checking and/or fine-tuning the neutral position of the transmission controls the selector finger in such a way that it passes at least once beyond a predetermined length or a predetermined area in the selection direction. The selector finger is subsequently controlled in such a way that it approaches a wall that is aligned in the longitudinal direction of the selection passageway by at least one increment, that is, by a predetermined very small distance, in the shift direction, or assumes a new position in the shift direction. The selector fork is subsequently moved again over a predetermined distance in the selection direction, preferably over the entire length of the selection passageway, before it is again moved incrementally in the shift direction. The orientation when sliding in the shift direction corresponds to the orientation that existed during the previous sliding movement in the shift direction. In that way, an approach to one of the selection passageway walls extending in the longitudinal direction takes place for so long until the selector finger is diverted into the selection direction by an approach in the shift direction. That deflection can be considered an indication that the selector finger has reached a stop device or a protrusion or the like of the longitudinal wall of the selection passageway wall, while sliding in the selection direction.

In that way the position of the longitudinal wall can be determined, thus allowing the selector finger to be moved over the entire length of the selection passageway, unhindered by stops or the like.

The position of the wall is then correspondingly determined for the opposite longitudinal wall of the selection passageway. To accomplish that, the selector finger can particularly be moved back to its starting position because, as a result of the incremental approach toward the first wall of the selection passageway, it is clear that the second, opposite wall of the selection passageway does not lie in that traveled area.

Based on such positions of the walls of the selection passageway, the neutral position can be determined in accordance with a predetermined characteristic value, particularly by establishing the mean value of the coordinates in the shift direction.

In accordance with a particularly preferred embodiment of the invention, the selector fork is shifted in incremental approaches not over the entire length of the selection passageway, but instead over predetermined partial lengths in the selection direction.

This makes it possible, in particular, for different sections of the longitudinal wall of the selection passageway to be differentiated with regard to their coordinates in the shift direction.

Since the precise position of the individual wall sections is then known, it is possible to select more direct passageways when shifting between various shift passageways, without running the risk of the selector fork striking a wall during shifting.

In accordance with the invention, the final gear positions can also be determined in a corresponding manner. Furthermore, the shift passageways can be measured this way. In particular the shift passageway widths can be determined. It should be noted that this measuring process using the above-mentioned device and/or the above-mentioned method can be performed by exchanging the selecting and shift passageways and/or the selection direction and shift direction.

However, since the shift passageways each merge into the selection passageway, this is preferably taken into account in accordance with a predetermined characteristic value.

Specifically, two shift passageways and/or shift passageway sections located opposite the selection passageway are treated as a unit, so that the selector fork is moved from a shift passageway section through the selection passageway into an opposite shift passageway and/or the opposite shift passageway section in the above-described manner. It is also preferred that the length of the respective shift passageway is determined initially, and that this length is subsequently taken into consideration in the movement in the shift direction. The length of the shift passageway can be determined especially by moving the selector fork in the shift

direction, and simultaneously actuating the selection motor. With the position sensing device it is possible to monitor when the position value changes by more than a predetermined amount in the selection direction. The measurement value for the shifting position at that location represents an end of the shift passageway. Starting from this point, the selector fork is moved in the direction of the shift passageway until it strikes the final stop device, so that the difference in length represents the shift passageway length. It is also possible to start this process at the final stop device in the shift passageway.

The object of the invention is further attained via a transmission system with a shift mechanism for its actuation, in accordance with claim 8.

This characteristic feature provides for the fact that a shift mechanism has an absolute position detection device. Starting from an unknown position of the selector fork and/or an unknown position of the selector shaft in terms of the coordinates within the selection-shift-passageway device, this absolute position detection device allows an absolute position in the selection direction and/or shift direction to be determined.

An absolute position in the shift direction and/or selection direction in accordance with this application should be understood as a position whose location is clearly established within the selection-shift-passageway device. In particular, the absolute position relative to the selection-shift-passageway device is established in the same way that a marking would be established at the base of this device. Preferably this absolute position is independent from wear that occurs on the passageway walls.

It should be noted that the process of determining and/or detecting this absolute position in accordance with this application is considered an absolute alignment. An absolute alignment is preferably performed in an event-controlled manner or at predetermined time intervals in order to set an increment counter at a predetermined starting value, such as zero.

In this manner, errors in the sensor system, factors that interfere with measurement signals, and defective evaluations that can lead to sum and thus position errors can be prevented from being perpetuated throughout the process.

Furthermore, the effects of a loss of absolute position, especially due to defective storage of the position or a resetting of the controls or other malfunctions, can be compensated for.

In accordance with a particularly preferred embodiment of the invention, the absolute position detection device is designed such that the absolute position of the selector shaft and/or the selector fork can be determined basically independently from the actuating forces of the shift mechanism. In particular, it is preferred that the absolute position can be determined independently from the amount of force that is applied by the actuating device, and especially by its motors.

It is preferred that, regardless of the amount of actuating force applied to the selector fork, the identical absolute position can be determined, and/or an identical position can be produced as the absolute position.

In accordance with a particularly preferred embodiment of the invention, the shift mechanism and/or the absolute position detection device has at least one sensor device and at least one signal area. This signal area can be scanned by the sensor device. In a preferred embodiment, the sensor device is designed as a digital sensor and/or the signal area is designed as a digital sensor area.

The signal area is arranged on the surface of the selector shaft. The signal area is formed especially by surface elevations and/or depressions in the selector shaft.

The signal area corresponds to a pattern that contains a plurality of field-configured areas and is projected into the selection-shift-passageway device. Each of those areas is assigned a predetermined signal (of the signal area).

When passing over and/or detecting a boundary between two areas that correspond to different signal values, the sensor detects a signal and/or the signal value change.

In a preferred embodiment, the absolute position detection characteristic controls the selector fork movement in accordance with a predetermined characteristic value. In a particularly preferred embodiment, this characteristic value is based upon the formation of the sensor area and/or the pattern. The characteristic value is designed such that the selector fork is initially controlled in one direction, in

which an absolute position can be safely determined in accordance with the pattern, independent of the selector fork position.

The invention is beneficial in that it makes it possible to perform an absolute alignment using a single sensor; however, several sensors can also be provided. It is also particularly preferred to use a digital sensor and/or switch on the selection motor and a digital sensor and/or switch on the shift motor. The usage of a digital switch on the selector shaft in particular makes it possible to use only a single switch and/or sensor rather than one switch per motor. A shift mechanism with both a sensor field and a sensor, in accordance with the invention, offers the additional advantage that the absolute position can be determined rapidly, with a high degree of accuracy, but with little effort. Furthermore, in accordance with the invention, it is possible to perform the absolute alignment in any gear.

The invention is also beneficial in that the absolute position can be determined independently from the elastic forces of the shift mechanism, especially from such forces as the elasticity of stops, e.g. passageway walls, and the elasticity of an actuating device, especially of a motor.

The influence of measuring inaccuracies can be reduced considerably and/or eliminated in accordance with the invention. Furthermore, it is beneficial that the wear of components has no influence on the determination of position.

In a particularly preferred embodiment the signal area is arranged on the selector shaft.

In accordance with a preferred embodiment of the invention, information as to the direction in which the selector fork is moved during a digital change and/or the direction (from digital signal 0 to digital signal 1 or from digital signal 1 to digital signal 0) in which the digital change takes place is taken into consideration when determining the absolute position.

It is preferred that the pattern and/or the signal area is designed in such a way that the absolute position in the shift direction and in the selection direction can be clearly determined with two movements of the selector fork. In a particularly preferred embodiment, the absolute position in the shift direction and in the selection

direction can be clearly determined with a maximum of three movements of the selector fork.

A movement is specifically a movement of the selector fork between a starting point and an ending point, between which the orientation and direction of travel are maintained.

In a particularly preferred embodiment, the field-configured areas of the pattern projected into the selection-shift-passageway device are aligned largely parallel to the axes of the passageways, i.e. the shift passageways and/or the selection passageway.

The sensor mechanism is preferably equipped with at least one sensor, preferably precisely one sensor, which can comprise electromagnetic calipers, a Hall effect sensor, an inductive sensor, an optical sensor, a capacitive sensor, a sound sensor system, an electric collector based upon a collecting bar, or some similar device, or a combination of the above.

In a preferred embodiment, the shift mechanism has an evaluation device, which assigns a predetermined position in the selection direction and/or shift direction to predetermined digital changes based upon a predetermined characteristic value. The pattern is preferably also stored in this evaluation device. In accordance with a particularly preferred embodiment of the invention, the pattern is designed such that in at least one shift passageway two areas, which represent different sensor signals, meet with a contact line that runs at least partially in the shift direction. It is also preferred that within the shift passageway those areas meet with a contact line that runs crosswise to the longitudinal axis of the shift passageway.

It is particularly preferred that within the selection passageway two areas, to which different sensor signals are assigned, meet with a contact line that runs at least partially in the longitudinal direction of the selection passageway. It is also preferred that within the selection passageway those areas meet with a contact line that runs at least partially crosswise to the longitudinal direction of the selection passageway.

In a preferred embodiment at least a first area of the pattern projected into the selection-shift-passageway device corresponds to a first digital value, and that at least a second area corresponds to the second digital value, which is different from

the first one, wherein the first area is located within the selection-shift-passageway device, especially in a cross-shape or H-shape.

In particular, a first partial area of a cross-shaped first area extends basically across the entire length of the selection passageway. A second partial area, which crosses this first partial area, is preferably arranged across the entire length of two shift passageways, which are arranged in series, crossing the selection passageway. In a preferred embodiment, this second partial area is arranged within the selection passageway around a position that is located between two shift passageways in the selection direction. It is preferred that in the area in which the partial areas of the first area intersect, i.e. in the area of overlap, a signal exists that corresponds to the second area. The partial areas of the first area preferably have a width that is smaller than the width of the shift passageway and/or the selection passageway.

It is also preferred that the first area is arranged in an H-shape within the selection-shift-passageway device. Specifically, a bridge connecting the two parallel columns of the "H" extends over the entire length of the selection passageway, while the columns extend in the shift passageways and cover them partially – in terms of their width. In a preferred embodiment, the "columns" rest against the walls of the shift passageways, wherein the two columns of the "H" rest against wall areas of the shift passageway that are oriented differently in the selection direction.

It is also preferred that a first area extends in the selection direction, basically covers the selection passageway, extends at least in part into the shift passageways, and beyond that is interrupted at a predetermined location in the selection direction so that in this area a second area exists, which extends across the entire width of the selection passageway.

The pattern is preferably designed such that the first area is arranged in a cross shape, wherein an extension of this cross – interrupted by the overlapping intersecting area – extends through the entire selection passageway, while a partial area of the cross oriented perpendicular to the above extends in two shift passageways that are located next to each other in the selection direction.

Preferably, the first area extends largely in the selection direction, covers the entire width of the selection passageway in this area, and extends further into the

adjacent shift passageways in the shift direction, wherein an area that is oriented perpendicular to this partial area of the first area, which extends in the selection direction, completely covers two shift passageways that are located opposite the above area in the shift direction, wherein the overlapping area in the shift direction and in the selection direction of the first area corresponds to the digital value of the second area.

In accordance with a particularly preferred embodiment of the invention, the hysteresis, which can contain a digital switch, is taken into consideration in the evaluating device.

The object is further attained via a transmission system that is actuated by a shift mechanism in accordance with claim 25.

A shift mechanism is envisioned, which contains a selection-shift-passageway device in which a selector fork, which can be controlled by an actuating device, can be displaced; the shift mechanism is also equipped with at least one selector shaft and at least one three-stage switch, which interacts with a component, such as the selector shaft, that can be moved during the shifting process, such that at least three different shifting modes can be differentiated or detected.

In particular, the profile of the outer surface of the selector shaft is such that it can be scanned by the three-stage switch. The profile is designed in particular in such a way that the radial outer profiled surface contains at least three areas that differ in their distance from the central axis of the selector shaft. Those three different distance values can be detected by the switch qualitatively and/or quantitatively.

Specifically, a first profile depth is assigned to the neutral position, and a second profile depth is assigned to the reverse position of the transmission. The areas of the selector shaft surface that contain no indentations form a third area.

Specifically, a mechanical switch scans those surface areas so as to determine whether the reverse or the neutral gear mode, or another shifting mode, has been assumed.

It should be noted that although the invention is explained in greater detail with reference to a mechanical switch, the usage of other switches is also covered by the invention.

The invention is beneficial in that it makes it possible to precisely detect predetermined transmission positions. Using those positions it is also possible to align an (incremental) position sensor. In accordance with the invention, a feature is provided so that when the vehicle is in the parking mode, the reverse gear is automatically engaged, so that when the reverse gear is detected by the three-stage switch, particularly during ignition, an (incremental) position sensor can be aligned. Most preferably a three-stage switch is provided, with which two predetermined transmission positions, such as the neutral gear mode and the reverse gear mode, can be precisely identified.

The object is further attained via a transmission system with a shift mechanism in accordance with claim 28.

In accordance with the invention, a shift mechanism for actuating a transmission system has a redundancy sensor device for examining and/or adapting a position sensor.

The shift mechanism is preferably equipped with a selection-shift-passageway device, in which a selector fork that is controlled by an actuating device, particularly a selection motor and a shift motor, can be displaced. The selector fork movement is tracked by a position sensor.

The redundancy sensor device can detect and/or detect predetermined transmission positions. A characteristic assignment value assigns predetermined positions that are detected by the position sensor to predetermined transmission parameters. Specifically, this characteristic assignment value assigns predetermined positions to the final gear positions and the neutral mode.

In a preferred embodiment in accordance with the invention, the characteristic assignment value can be checked for accuracy based upon the values that are produced by the redundancy sensor device.

In particular, the redundancy sensor device detects when transmission assumes the final gear positions and/or the neutral mode. The characteristic

assignment value assigns predetermined position values to those final positions. Those position values can be compared to the position values indicated by the position sensor in the final gear positions and/or the neutral mode.

When a deviation is detected that exceeds a predetermined value, the position values can be adjusted to the characteristic assignment value.

The object is further attained via a transmission system with a shift mechanism in accordance with claim 29.

The profile of the selector shaft is such that it contains different areas of potential with regard to the selector shaft axis. Specifically, the final gear positions and the neutral mode are designed as indentations within the selector shaft. A retainer has a spring-loaded ball, which presses against the selector shaft and rests in the appropriate indentations in the "final gear position" and/or "neutral position" shifting modes. The ball thus takes on a potential that differs from the potentials it assumes when it is outside of the final gear position and/or neutral mode.

Preferably, the final gear positions and/or the neutral mode are assigned to the same potential profile. It is also preferred that each of those positions is assigned a potential that is specific to it alone.

In or on the retainer, a sensor device and/or a switch is arranged, which tracks and/or monitors the movement of the ball, particularly in a translatory direction. In this manner, conditions in which the ball rests in the indentations within the selector shaft that are provided for the final gear positions and/or the neutral mode can be recognized. The signal that is thus detected by the sensor device and/or the switch can be used to monitor the selection motor and/or the shift motor and/or the (incremental) position sensor assigned to those motors. Specifically, in the case of a characteristic assignment value that comprises a control device for controlling the actuating device, and assigns predetermined position values of the actuating device to predetermined transmission positions, such as a final gear position and/or a neutral mode, the accuracy of this assignment can be checked.

Thus, especially when the sensor has detected that the ball has come to rest in an indentation in the selector shaft, it is possible to check whether the values produced by the position sensor at that time agree with those values that are

assigned to a final gear position and/or the neutral mode in accordance with the characteristic assignment value. If this is not the case, it indicates an error in the assignment characteristic and/or the position sensor. In a preferred embodiment a position value, especially the position value that is closest to the position value currently indicated by the (incremental) position sensor, is adjusted to coincide with the position value of the incremental position sensor, i.e. the characteristic assignment value is adapted.

The object is further attained via a transmission system with a shift mechanism in accordance with claim 34.

In accordance with the invention, the shift mechanism contains a neutral reference device.

The neutral reference device allows neutral reference movement to be initiated and executed. Neutral reference movement involves a determined sequence of actuations by the actuating device and/or the selector and/or shift motor and/or the selector fork, with which, starting from an unknown selector fork position, the neutral gear can be engaged; in this case, missing information, such as missing information as to the position of the selector fork, can be determined via tactile and pressing processes, and their evaluation.

A tactile process is a process in which the selector fork travels in a predetermined direction until a stop device is detected, and/or in which the actuating device and/or the selection motor and/or the shift motor is controlled until a stop device is recognized or a maximum passageway has been traversed.

A pressing process is a process in which the selector fork travels in a predetermined direction until a movement of the selector fork in this direction is recognized, and/or in which the actuating device and/or the selection motor and/or the shift motor is supplied with current until a movement by the selector fork and/or the actuating device has been detected.

In accordance with the invention, when the selector fork is being controlled, predetermined selector fork movements are prevented, and/or the selector fork is controlled in such a way that predetermined movements of the selector fork, which have been established by direction and orientation, cannot occur. In particular, the

invention provides that those impermissible selector fork movements and/or directions and orientations are such that it can be ensured that the selector fork will not move into predetermined, critical shift passageways during the neutral reference movement. A critical shift passageway is a shift passageway that is assigned to a gear, which, when engaged in the presence of predetermined operating parameters, such as the r.p.m. of an internal combustion engine or the speed of the vehicle, runs the risk of damaging the transmission system.

Those critical gears are preferably established, based upon predetermined, currently existing operating parameters, i.e. dynamically.

In accordance with a particularly preferred embodiment of the invention, the selector fork is controlled during neutral reference movement by the neutral reference device only in the orientations of the selection passageway longitudinal direction and in directions having a vector component in the selection direction and a vectorial component in the shift direction, wherein the vector that is composed of those vectorial components is directed and oriented in accordance with predetermined criteria. Those predetermined criteria include, specifically, that the vector is not parallel to a vector that is oriented from a random point on the selection passageway to a random point on a critical shift passageway; only points in a selection passageway that are located outside the areas that represent an intersecting area between the selection passageway and the critical shift passageways are considered.

In accordance with a particularly preferred embodiment of the invention, the first gear and the reverse gear are established as critical gears.

The selection-shift-passageway device is most preferably designed as a double-H shifting pattern. It is also preferred that, in such a double-H pattern, the shift passageways of the first, the third and the fifth gears are arranged along the top from left to right next to one another, while the second, the fourth and the reverse gears are arranged along the bottom, i.e. across from the selection passageway, from left to right, so that first gear and reverse are arranged diametrically opposite one another toward the outside.

In accordance with a particularly preferred embodiment of the invention, the neutral reference device starts the neutral reference movement when one or more initiating conditions have been detected.

A preferred initiating condition exists when during operation it is determined that different information about the engaged gear exists. Specifically, an initiating condition exists when, with a disengaged clutch – based upon the r.p.m. of the internal combustion engine and the wheel revolutions - a gear is detected that does not agree with the gear that is detected at the same time based upon the position sensor. Such a situation exists especially when the actuating device has selected the wrong gear.

Another preferred initiating condition exists when – especially due to defective contacts or interference – incorrect signals are received from the incremental sensors on the transmission actuating device which have not been identified as incorrect, so that the actuating device selects incorrect positions and/or engages incorrect gears and/or detects unexpected stops in the transmission.

Another preferred initiating condition exists when a control device for controlling the actuating device is reset or switched off temporarily – especially due to battery failure – so that the selector fork position is lost or erroneous.

Another preferred initiating condition is given when a control device for controlling the actuating device is newly installed or has been replaced.

In accordance with a particularly preferred embodiment of the invention, a neutral reference device initiates neutral reference movement only when certain operating conditions exist. Such operating conditions can be operating conditions that are representative of an intended driving mode, the interruption of which is typically not intended. In particular, a neutral reference device initiates neutral reference movement only when it has been ensured that the vehicle, which contains a shift mechanism in accordance with the invention, is not in the kick-down operating mode.

Preferably, a neutral reference device initiates neutral reference movement only when the speed of a vehicle that has a shift mechanism in accordance with the invention falls below a predetermined speed value. It is most preferred that a neutral

reference device initiates neutral reference movement only when a vehicle with a shift mechanism in accordance with the invention is standing still.

Most preferably, neutral reference movement is initiated only when predetermined throttle valve angles have been detected in a vehicle with a shift mechanism in accordance with the invention.

In accordance with a particularly preferred embodiment of the invention, the neutral reference device prevents predetermined shifting processes, especially the engaging of a gear, during neutral reference movement.

In accordance with a particularly preferred embodiment of the invention, reference movement is interrupted and/or repeated, or a shutdown is initiated, when predetermined error conditions exist.

In accordance with a particularly preferred embodiment of the invention, a neutral reference device starts the neutral reference movement under predetermined conditions. If predetermined operating conditions are detected, especially when it can be determined that neutral reference movement is not dangerous, a LR tactile process is initiated. A LR tactile process is a tactile process, which is comprised of a left tactile process followed by a right tactile process. The selection motor is supplied with current in such a way that the selector fork is controlled to the left in the selection direction. When the selector fork reaches a stop and/or has traversed a maximum distance, the selection motor is supplied with current in such a way that the selector fork is steered to the right in the selection direction.

It should be noted that the directions left (L) and right (R) represent opposite directions in the selection direction; they are assigned to the shifting pattern in accordance with a pre-established characteristic. Hereinafter, information provided about left and right refers to a double-H shifting pattern in which the first, the third and the fifth gears are arranged from left to right on one side of the selection passageway, and the second, the fourth, and the reverse gears are arranged on the other side of the selection passageway.

In the shift direction a differentiation is made between forward (F) and rear (R) movements. Those directions are oriented opposite one another in the shift direction. The "forward" direction is oriented from the selection passageway toward the shift

passageways of the first, the third and the fifth gears, while the "rear" direction, viewed from the selection passageway, is oriented toward the shift passageways of the second, the fourth and the reverse gears.

It should be noted that the establishment of those directions shall not serve to limit the invention.

When during a LR tactile process a large width is detected and/or the stops are farther apart than a predetermined passageway difference, the neutral reference device concludes that the selector fork is within the selection passageway. Since the R-tactile process follows the L-tactile process, the conclusion can be made that the neutral gear is engaged at the right end.

If the LR tactile process has produced a width and/or a distance to the stops that is below a predetermined value, it can be concluded that the selector fork is in the shift passageway.

The neutral reference device then initiates a F-tactile process with simultaneous R-pressing. If no stop is detected, or if, due to the R-pressing, a process is initiated, the neutral reference device subsequently initiates a RLR tactile process, i.e. scanning to the right, then scanning to the left, then scanning to the right again, for monitoring purposes. In this manner the system can check whether the selector fork is actually located within the selection passageway. If a distance is detected between the stops that is greater than a predetermined distance, it is concluded that the selector fork is actually located in the selection passageway, and since the last tactile process was to the right, the selector fork is located on the right side of the selection passageway.

If during the F-tactile process with simultaneous R-pressing a stop is detected, it can be concluded that the selector fork is located in one of the shift passageways of the first, the third, or the fifth gears – based upon the above-described example of a shifting pattern. This determination will also be made by the neutral reference device when the RLR tactile process produces a small distance between the stops. In both cases, a R-tactile process with a simultaneous L-pressing process is subsequently initiated. If no stop is detected or if the pressing to the left is successful, i.e. if a process is detected, a LR-tactile process is then initiated for

control purposes by the neutral reference device. If during this LR tactile process a distance is detected that is greater than a predetermined distance value, it is determined that the selector fork is located within the selection passageway, specifically at its right end.

In accordance with a particularly preferred embodiment of the invention, the neutral reference device can detect the position of the selector fork in the direction of the shift passageways upon locating the selection passageway. In this process, it is preferred that, starting from the left or the right selection passageway end, the selector fork is moved a predetermined distance in the selection direction, wherein this predetermined distance is established in accordance with a predetermined characteristic, such that the selector fork is basically positioned in the center between two shift passageways which are located adjacent to one another in the selection direction within the selection passageway. The neutral reference device then advances the selector fork in the shift direction, with a predetermined orientation, until a stop (against a passageway wall) is detected. In order to prevent slipping into one of the adjacent shift passageways, the selection position is monitored during the movement in the shift direction. If a change in the selection direction that is greater than a predetermined change is detected, then the selector fork movement is interrupted.

In accordance with a particularly preferred embodiment of the invention, the neutral reference device initiates neutral reference movement when, after the control device has been switched on, predetermined aggregates are operating without the benefit of predetermined parameters from the shift mechanism, such as the position of the selector fork.

The object is further attained by a transmission system with a shift mechanism, in accordance with claim 46.

In accordance with the invention, a device is provided via which the selector fork can be pressed and overpressed against a predetermined stop under predetermined conditions, after which the selector fork is again released by this device; the selector fork then assumes a largely force-free position, which allows the establishment of a predetermined parameter of the transmission geometry. In

accordance with a particularly preferred embodiment of the invention, the stop is formed by a passageway wall, e.g. a shift passageway, wherein the selector fork assumes a predetermined position, which assigns a characteristic assignment value comprised by the device to the force-free final gear position and/or the neutral position. The force-free final gear position and/or the neutral position are the positions of the selector fork at which the gear is completely engaged, and the shift mechanism is largely tension-free.

In accordance with a preferred embodiment of the invention, the selector fork is additionally or alternatively pressed against the shift passageway wall in the end area of the shift passageway in the selection direction, overpressed, and then released again; it is preferably released in a controlled manner, wherein the selector fork assumes a predetermined position, which allows the establishment of a neutral position in accordance with a predetermined characteristic value.

The selector fork moves into the predetermined position due to the release process and/or the (elastic) restoring force.

There preferably is no tension in the shift motor and/or the selection motor during the releasing process. It is particularly preferred that the shift motor and/or the selection motor experience less tension during the releasing process, in accordance with a predetermined characteristic, than when pressed against the stop and/or during the overpressing process. It is most preferred for the device to perform the pressing, overpressing, and release at predetermined time intervals and/or when predetermined conditions occur. It is also preferred for a pressing, overpressing, and controlled release of the selector fork to be performed on two opposite walls within the shift passageways, in order to deduce the width of the shift passageway in accordance with a predetermined characteristic from the generated force-free positions.

It is particularly preferred that the stops – especially in the above-described form – are detected by monitoring predetermined parameters and/or their progression, such as the tension in the selection motor and/or the shift motor.

In accordance with a particularly preferred embodiment of the invention, a position sensor is monitored and/or the appropriate position values are adapted

based upon the established force-free positions and/or the neutral positions and/or the positions that are created during the releasing process. Specifically, a position that is created in the selection direction and/or in the shift direction upon release of the selector fork is used to initialize or align an incremental position sensor.

In accordance with a particularly preferred embodiment of the invention, an (incremental) position sensor detects the change in position of the selector fork during the releasing process.

The object is further attained by a shift mechanism for actuating a transmission system in accordance with claim 50.

In accordance with the invention, a shift mechanism, which has a selection-shift-passageway device, within which a selector fork can be easily moved relative to the longitudinal walls of the passageways, has at least one gear coding device.

With this gear-coding device, the respectively engaged gear can be coded in such a way that its identity can be checked, independent of the position of the selector fork, which the selector fork assumes when it is checked within the selection-shift-passageway device. It should be noted that this does not necessarily exclude the possibility that the selector fork movement can be tracked by a position sensor during the coding or decoding process. In accordance with the invention, however, it is preferable for decoding to be possible without a position sensor tracking the selector fork movement during decoding.

In accordance with a particularly preferred embodiment of the invention, the identity of an engaged gear can be determined, wherein the selector fork remains in its final gear position and/or neutral position, especially during decoding.

The selector fork is preferably moved into its neutral position in accordance with a predetermined characteristic in order to decode the gear identity information.

In accordance with a particularly preferred embodiment of the invention, decoding the identity of the engaged gear is determined based upon predetermined geometric parameters for the shifting gate of the transmission and/or the selection-shift-passageway device.

It is particularly preferred that, when engaging a gear, the selector fork is controlled in such a way that it is positioned in predetermined positioning areas within

the neutral position and/or the final gear position, which possess extra clearance room in the selection direction and in the shift direction; the location of those predetermined position areas within the final gear position depends upon the identity of the engaged gear, in accordance with a predetermined characteristic.

In a particularly preferred embodiment of the invention, for purposes of decoding, the selector fork is moved within the final gear position, in accordance with a predetermined characteristic value, wherein the passageways of movement – i.e. especially the possible travel passageways – are detected in the selection direction and/or in the shift direction. Based upon a comparison of the passageways of movement that are determined using the predetermined characteristic value, in accordance with which the selector fork rests in a predetermined area that is dependent upon the gear when the gear is engaged, the identity of the gear can be decoded.

When determining the passageways of movement of the selector fork in the neutral position, a position sensor preferably tracks the movement of the selector fork. Based upon the measurement values detected this way, the position of the selector fork, and thus the gear identity, can be determined, especially based upon the distance to the adjacent walls.

In accordance with a particularly preferred embodiment of the invention, the gear identity can be determined independent from a position sensor that is active during the decoding process. The selector fork is preferably positioned on the walls of the shift passageway, in accordance with a predetermined characteristic value, during the coding process. Such a position involves especially resting against a longitudinal wall. A second position involves especially resting against a second longitudinal wall that is located opposite the first longitudinal wall. A third position involves especially resting against a longitudinal wall and a transverse wall. A fourth position involves especially resting against a longitudinal wall and a transverse wall, but in a different corner. For decoding purposes, a check can be performed in accordance with a predetermined characteristic value as to whether or not a passageway of movement exists in a predetermined direction. In accordance with to this characteristic value, the engaged gear step can be deduced.

In accordance with a particularly preferred embodiment of the invention, the shift passageways have different shift passageway widths, so that it is possible to check which gear has been engaged based on the established shift passageway width.

In accordance with a particularly preferred embodiment of the invention, the neutral position of the gears is designed to be rectangular in shape, wherein the gear identity is encoded by moving the selector fork to one of the four corners of this rectangle when engaging the gear, or by moving the selector fork basically to the center between two corners along an edge of this rectangle.

It should be noted that the final gear position can also be designed to have a shape other than a rectangle; the idea of differentiating between left, right, center, top and bottom for the purpose of positioning the selector fork to encode the gear identity information can also be transferred to final gear position areas having different designs.

The traversing length to the respective stops, which are formed by the passageway walls, enables a decoding of the gear identity information.

The invention is beneficial in that it makes it possible to determine the identity of the engaged gear and/or to determine the starting values for incremental measuring of the shifting and/or selection motor, and/or to check the incremental position sensor for plausibility without disengaging the current gear.

It is further possible to perform an alignment of the incremental passageway measurement process, which is especially beneficial in the case of failure of the central control unit.

In accordance with a particularly preferred embodiment of the invention, the gear coding device allows the encoded gear identity to be decoded, based upon geometric parameters of the shifting gate transmission and/or the selection-shift-passageway device, such as the shift passageway width, etc.

In accordance with a particularly preferred embodiment of the invention, the gear identity can be determined via at least two different devices. Specifically, the gear identity process can be performed on one hand based upon the position values provided by an incremental position sensor, in accordance with an assignment by a

position gear identity characteristic, and on the other hand based upon a gear-coding device in the above-described form.

The object is further attained by a shift mechanism for actuating a transmission system in accordance with claim 62, with this shift mechanism being equipped with a selection motor monitoring device. From this selection motor monitoring device the selector fork, which can be displaced in a selection-shift-passageway device, can be controlled while engaging and/or disengaging a gear, in accordance with a predetermined characteristic value, in the selection direction, such that the selector fork executes a superimposed movement in the selection direction apart from a movement in the shift direction. To this end, the selector fork exhibits clearance within the shift passageways in the selection direction, which provides the selector fork with mobility in the selection direction.

The movement of the selector fork is tracked by a position sensor, especially by an incremental distance sensor, which tracks the movement of the selector fork in the selection direction. If the passageway of movement of the selector fork that is controlled by the predetermined characteristic value in the selection direction does not agree with the passageway of movement detected by the position sensor, a malfunction of the selection motor and/or its position sensor can be deduced.

The invention is beneficial in that it enables a malfunction of the selection motor and/or its position sensor to be detected at a very early stage, without time-intensive measures.

It is particularly preferred a movement in the selection direction is superimposed at a very early stage in the disengaging of the gear within the shift passageway.

The object is further attained by a transmission system with a shift mechanism in accordance with claim 63.

In accordance with the invention, a shift mechanism for actuating a transmission system has a gear plausibility monitoring device, which makes it possible to check whether or not a gear is engaged, and/or to determine its identity. The gear plausibility monitoring device makes those determinations basically independent of the elasticity values of selector fork components. The gear

plausibility monitoring device also makes those determinations independent of elasticity values exhibited by the components in the transmission passageway between a position sensor that is arranged on the actuating device and a shifting fork.

The invention is especially beneficial in that it eliminates the influence of elasticity values of components, which can distort the selector fork positions determined by a position sensor. Thus, in accordance with the invention, there is no risk that an especially elastic expansion in the above-mentioned transmission passageway can be understood by a position sensor as a passageway change for the selector fork that would correspond to this dimension of expansion, although the selector fork has not even traversed this passageway.

In accordance with a particularly preferred embodiment of the invention, the gear plausibility monitoring device monitors the deviation between the target position and actual position of the selector fork – especially in the selection direction – and monitors the supply of current to the selection motor.

Supplying the motor with current controls a predetermined final gear position. The position indicated on the position sensor in the selection direction is compared to the target position, which the selector fork and/or the selection motor is supposed to assume in the neutral position. If the current position deviates from the target position by less than a specified limit, and the selection motor and/or the selector fork reaches the target position after a predetermined period of time, i.e. it enters the switch-off hysteresis, and/or if, a predetermined time after reaching the target position, the selection motor and/or the selector fork remains in the switch-off hysteresis for at least a predetermined period of time, the gear plausibility monitoring device recognizes that the affected gear has been engaged.

In accordance with a particularly preferred embodiment of the invention, the predetermined limit is set to the value of the passageway width.

The object is further attained by a transmission system with a shift mechanism in accordance with claim 66.

In accordance with the invention, a shift mechanism has at least one gear plausibility monitoring device, which recognizes the identity of a gear as being

engaged when the measured position data and/or position value of the selector fork or sliding sleeve corresponds to that of the desired and/or engaged gear, and the gear ratio that has been determined based upon the transmission input shaft r.p.m. and wheel r.p.m. corresponds with this gear. The allocation between this gear ratio and the engaged gear is preferably stored in a characteristic assignment value.

The object is further attained by a transmission system with a shift mechanism in accordance with claim 67.

In accordance with the invention, a shift mechanism for actuating a transmission system has at least one gear recognition device, with which a vehicle clutch can be completely engaged in a controlled and deliberate manner. After ensuring that the vehicle clutch has been engaged, the engaged gear ratio is determined in the engaged clutch, based upon the engine speed and the speed of one wheel of the motor vehicle. This gear ratio is then compared with the gear ratio that is assigned to the respective gears, in accordance with a predetermined characteristic assignment value. If an agreement of the gear ratio and/or an agreement within the framework of a specified tolerance setting has been established, the appropriate gear is recognized as being engaged.

The invention is especially beneficial in that, based upon information gained this manner with regard to an engaged gear, a position sensor, especially an incremental distance sensor, which is arranged on the selection motor and/or the shift motor, can be checked and/or aligned. The prior controlled and deliberate disengaging of the clutch ensures that the gear ratio, which has been calculated based on the speed, actually corresponds to the speed ratio of a gear. This prevents, in a controlled and deliberate manner, the calculation of a gear ratio that does not correspond to the engaged gear, due to a slipping of the clutch or some similar event.

In accordance with a particularly preferred embodiment of the invention, the transmission system with a shift mechanism is used in a motor vehicle, which contains a vehicle clutch with a hydraulic clutch release system. In order to ensure the accuracy of this clutch release system and/or to decouple the necessary adjustments caused by outside influences, such as temperature, the clutch release

system preferably contains a volume control device, which allows the volume of hydraulic fluid contained in a predetermined section of the hydraulic system to be set to a predetermined volume at predetermined intervals and/or under predetermined conditions. The gear recognition device most preferably detects the engaged gear during such a volume control process.

In accordance with a particularly preferred embodiment of the invention, the gear recognition device controls a movement in the transmission and/or a selector fork movement during the process of detecting a gear. This controlled movement causes the selector fork to move in the gear passageway in which it is currently located, all the way to the end stop that faces away from the selection passageway. In this stop position, a new initialization of the passageway measurement process by an incremental position sensor takes place.

In accordance with a particularly preferred embodiment of the invention, the gear recognition device is activated when preset conditions are detected. Specifically, the gear recognition device is activated when sensor problems are noticed.

The object is further attained by a control device for controlling a shift mechanism of a transmission system in accordance with claim 70, which controls the actuating device of the shift mechanism, i.e. the selection motor and the shift motor. This control device is designed as an electric device, which preferably supplies the selection motor and/or the shift motor with tension and/or current in accordance with a predetermined characteristic value.

The object is further attained with a method in accordance with claim 71.

In accordance with the invention, a method for controlling a shift mechanism is envisioned, which in accordance with a predetermined characteristic value makes it possible to establish predetermined geometric parameters and/or predetermined geometric transmission parameters and/or predetermined parameters of the selection-shift-passageway device based upon an unknown selector fork position.

In accordance with the invention, starting from this unknown position, the selector fork is controlled such that it will be displaced in the selection direction and/or in the shift direction for the purpose of determining the current, maximum

possible passageways of movement. Those passageways of movement are evaluated based upon a predetermined characteristic value, wherein the evaluation result determines and produces a new selector fork position. Starting from this new position, the passageways of movement that exist in the shift direction and/or in the selection direction are determined again, before they are again evaluated, and, based upon the evaluation result, a new position is assumed. This process is repeated until the predetermined transmission parameters have been completely established.

The object is further attained with a method in accordance with claim 72.

In accordance with the invention, a predetermined position will be assumed within the selection-shift-passageway device based upon a predetermined characteristic value. Preferably, the selector fork is moved in accordance with a predetermined characteristic value, starting from this predetermined position, such that predetermined geometric transmission parameters can be established.

In accordance with a particularly preferred embodiment of the invention, the neutral position and/or the synchronous positions and/or the passageway positions and/or the passageway widths can be detected via predetermined methods.

It is particularly preferred that the end points of the passageways of movement, i.e. especially the passageway walls and/or stops, are determined indirectly at least part of the time and/or at least partially.

To this end, predetermined operating parameters are monitored, and, based upon their progression over time, a conclusion is drawn with regard to stops, passageway walls, etc. in accordance with a predetermined characteristic value.

The object is further attained with a method in accordance with claim 75.

The method for controlling a shift mechanism for actuating a transmission system is designed such that – particularly starting from an unknown selector fork position within the selection passageway – the selector fork is controlled, shifting the selector fork lengthwise along the selection passageway. The distance of this movement is specified. The distance is preferably specified such that the selector fork is moved in a predetermined direction to the end of the selection passageway. The selector fork is then shifted incrementally, especially by a single increment, in the

shift direction in a predetermined orientation. It is also preferably moved in the shift direction to the other end of the selection passageway with unchanged coordinates. After moving incrementally in the shift direction, the selector fork is moved over a predetermined length in the selection direction, preferably over the entire length of the selection passageway. During this process, a position sensor, which tracks movements of the selector fork in the shift direction, is monitored. If this position sensor does not indicate movement in the shift direction when the selector fork is being advanced in the selection direction, the selector fork is again moved incrementally in the shift direction, in the same direction in which it was already moved, in increments, in the shift direction. The selector fork is then advanced again in the selection direction – over a predetermined length, or over the entire selection passageway length. Once again, a position sensor, which tracks the selector fork movement in the shift direction, is monitored. If this position sensor does not indicate a passageway change in the selection direction during the moving process, the selector fork is again displaced in the shift direction with the same orientation. This process of advancing the selector fork in the selection direction while monitoring the position of the selector fork in the shift direction, followed by the subsequent incremental shifting of the selector fork in the shift direction, with the same orientation, and a renewed shifting back in the selection direction while monitoring the shifting position is continued until during the process of moving in the selection direction the selector fork is deflected in the shift direction, or the selector fork is blocked in the selection direction before reaching a predetermined distance, i.e. before it has traversed the entire length of the selection passageway.

If such a deflection is detected, it can be concluded that the selector fork has come into contact with a wall, a stop, or some similar device, and has been stopped or deflected by it. The position that exists during this deflection process in the shift direction and/or the position in the shift direction that existed before the last incremental movement forms a boundary for the neutral position, which extends in the selection direction and is located on a first side of the neutral passageway center. Accordingly, the selection passageway wall opposite this first limit and/or wall can be scanned in order to determine a second limit for the selection passageway. Those

limits form the boundaries of the neutral position in the shift direction. It is also preferred that, based upon those limits, the neutral position is determined based upon a predetermined characteristic, especially by determining the average of the coordinates of the boundaries in the shift direction.

This method for determining the neutral position can also be applied accordingly to the determination of the final gear positions. There the shift direction and the selection direction and/or the shifting and selection passageways are reversed from the above description.

This method also allows the position of the passageway walls and/or the surface profile of the passageway walls to be determined in sections.

The object is further attained with a method in accordance with claim 82.

In accordance with the invention, the selector fork is moved into a predetermined absolute position in the selection direction and/or the shift direction, wherein this controlling of the absolute position is independent of information as to the starting position of the selector fork and/or the selector shaft. To this end, a feature is provided for controlling predetermined movements of the selector fork, wherein at the same time a sensor's, especially a digital sensor's, field that is moved in conjunction with this selector fork movement – possibly in accordance with a predetermined transformation – is scanned. This sensor field is designed such that it is divided into different areas, and during the transition of those areas the sensor registers the transition. Dependent upon this sensor signal change and/or digital change, and/or based upon the orientations in which the selector fork is moved and/or the directions in which the digital changes occur, i.e. from digital value "0" to digital value "1" or vice versa, the position currently being approached by the selector fork is deduced. The sensor field is designed such that, based upon the digital change, possibly in consideration of the direction of the digital change and/or the direction and/or orientation in which the selector fork is being moved when a digital change occurs, an absolute selection and/or shifting position of the selector fork can be detected. This absolute position is determined in particular by the fact that it is clearly defined in relation to the selection-shift-passageway device. Specifically, it is

a predetermined position that is attached to the base of the selection-shift-passageway device.

In accordance with a particularly preferred embodiment of the invention, an (incremental) position sensor is set at a predetermined value for the purpose of detecting the passageway in the shift direction and/or in the selection direction when an absolute position in the selection direction and/or the shift direction is detected or when it is determined that the selector fork is assuming this position.

Most preferably, absolute positions for the selector fork in the selection direction and in the shift direction are approached separately.

The object is further attained with a method in accordance with claim 85.

A method in accordance with the invention provides for neutral reference movement to be implemented and/or controlled under certain conditions.

The neutral reference movement contains tactile processes as well as pressing processes.

In accordance with a particularly preferred embodiment of the invention, a tactile process in the shift direction is performed only in connection with a pressing process in the selection direction.

In a preferred method in accordance with the invention, neutral reference movement is initiated only when predetermined conditions are detected. Specifically, neutral reference movement is initiated when it is determined that the passageways of movement of the selector fork that are assigned to a predetermined position in accordance with a predetermined characteristic value do not agree with the actual passageways of movement. In this application, a passageway of movement should be understood in that, starting from this position, the selector fork can be moved in predetermined directions, especially in a selection direction and/or in a shift direction, a predetermined distance in a predetermined orientation, without hitting a stop device, such as a passageway wall.

The object is further attained via a method in accordance with claim 96.

In accordance with the invention, the selector fork of a shift mechanism, which is movably mounted in a selection-shift-passageway device, is moved in the direction

of a passageway wall and/or is moved against this passageway wall, where it is overpressed.

It should be noted that in accordance with the invention overpressing is preferably performed in a controlled manner with a predetermined amount of force.

Due to the overpressing, certain components deform elastically, especially the selector fork. It should be noted that this elastically deformed state, and/or the fact that a corresponding restoring force exists, is also referred to within the framework of this application as latent elasticity, while the corresponding unstressed resting position and/or the freedom from force of the component is described as unstressed elasticity.

The selector fork is then released. This releasing process can be a releasing process that extends down to zero. It is also preferable for the force with which the selector fork is pressed against the wall is reduced, such that the forces produced by the elastic forces of the selector fork or similar devices are greater than the force still being applied to the selector fork.

As a consequence, the selector fork moves back in the direction of the passageway, i.e. inward, away from the passageway wall. The (elastic) restoring forces are thus decreased, and the selector fork assumes a predetermined and/or previously known position within the passageway configuration relative to the stop at which it was overpressed. During this reverse movement, the change in position of the selector fork is preferably monitored. The change in position of the selector fork is preferably also monitored beforehand on a continuous basis, in which process a position sensor can be used. The final value, which this position sensor assumes when the selector fork has reached its unstressed position and/or this position, is a characteristic position. This characteristic position is stored, so that at least its coordinates in an orientation that is perpendicular to the passageway wall are known beforehand. Furthermore, this position allows the determination of the neutral position in the selection direction and/or in the shift direction, in accordance with a predetermined characteristic value.

This derived neutral position is then compared with the stored neutral position. If deviations exist that exceed a predetermined deviation, the stored neutral position and/or the position sensor and/or its values can be adapted.

The value indicated by the position sensor is also preferably compared with the coordinates and/or with a coordinate that is perpendicular to the wall over which the selector fork is overpressed, wherein, in the case of deviations that exceed a predetermined deviation, the value that is indicated by the position sensor is adapted, and/or a predetermined test routine is initiated.

The object is further attained with a method in accordance with claim 98.

The object is further attained with a method in accordance with claim 99.

In accordance with the invention, a method is provided with which a shift mechanism for actuating a transmission system can be controlled. The shift mechanism has a selection-shift-passageway device, in which a selector fork is movable. The method in the invention allows the width of predetermined passageways of this selection-shift-passageway device to be determined.

In accordance with a predetermined characteristic value, the selector fork is moved and/or controlled within the passageway, such as the selection passageway or the shift passageway, in a transverse direction, i.e. toward a longitudinal wall. Upon reaching the wall, the selector fork is overpressed on this wall, in accordance with a predetermined characteristic value, such that elastic deformations of the selector fork and/or the selector shaft and/or another component are caused. The selector fork is then released in accordance with a predetermined characteristic value, so that the selector fork is moved toward the passageway as a result of those releasing deformations, i.e. as a result of to the restoring forces, and assumes a neutral position.

It is particularly preferred that the process in which the selector fork is released occurs such that the force controlling the selector fork is set to zero. Most preferably, the force applied to the selector fork is reduced in accordance with a predetermined characteristic value during the releasing process.

The approach of a passageway wall, the overpressing of the selector fork, and the subsequent releasing process relative to the opposite passageway wall are

preferably repeated, so that here, as well, a characteristic, unstressed neutral position is determined. Based on those characteristic positions, the passageway width is then determined.

For this purpose, the relative orientation of the characteristic positions of the unstressed selector forks relative to the adjacent walls is stored in a characteristic assignment value.

In a preferred embodiment, an indirect method indicates when the selector fork stops at the outside wall. For this purpose, the shifting and/or selection motor is monitored, and based on its position sensor the stop is detected.

The stopping is also preferably registered via a force measuring process. In accordance with a particularly preferred embodiment, the monitoring of the armature current in the selection motor and/or in the shift motor, or the tension, or some other predetermined operating variable in accordance with a predetermined evaluation characteristic allows a stopping of the shifting lever at the passageway wall to be detected. Other methods, especially those mentioned above, are also preferred for use in detecting the stop.

In accordance with a particularly preferred embodiment of the invention, an unstressed position, i.e. a position assumed by the selector fork after overpressing and the subsequent releasing process, is used to align a predetermined, stored position. Most preferably, a stored neutral position adapts the neutral position that has been determined in the above-described manner by overpressing the selector fork.

It is also preferred that another operating parameter, especially a stored passageway width, is adapted accordingly.

The object is further attained with a method in accordance with claim 102.

In accordance with the invention, a method for controlling a shift mechanism of a transmission system is provided, which contains a selection-shift-passageway device within which a selector fork can be moved. At least in its final gear position and/or its neutral position, the selector fork exhibits clearance from the respective shift passageway walls. This clearance preferably exists in the shift passageway width, and most preferably also exists in the shift direction. In accordance with the

invention, the identity of an engaged gear is encoded in accordance with a predetermined characteristic when this gear is engaged. The selector fork is most preferably displaced in a predetermined position area within the clearance range of the final gear position for the coding process. This position area is assigned to the identity of the engaged gear, in accordance with a predetermined characteristic assignment value.

The gear identity information can then be decoded at a later time.

In accordance with the invention, it is not detrimental when the position information, especially of an incremental position sensor, is lost between the encoding and decoding processes. In accordance with the invention, the engaged gear is maintained during decoding, i.e. the selector fork is basically not moved out of its final gear and/or neutral position.

In accordance with a particularly preferred embodiment of the invention, the selector fork is displaced in the direction of the shift passageways and/or in the direction of the selection passageway within the final gear and/or neutral position for the purpose of decoding, wherein preferably walls or boundaries of the neutral position and/or the respective shift passageway are approached, so that the engaged gear is determined especially using the travel length and/or the distance to a wall.

The object is further attained with a method in accordance with claim 104.

In accordance with the invention, a selector fork, which is arranged in a selection-shift-passageway device such that it can be moved, is provided with clearance between it and the walls of the shift passageway in the selection direction, within at least one shift passageway. In order to detect a malfunction of the selection motor and/or its position sensor, the selector fork is controlled such that it is moved within a shift passageway, in accordance with a predetermined characteristic value, under predetermined conditions and/or at predetermined times, in the selection direction. It is particularly preferred that this movement in the selection direction – preferably always – occurs when a gear is being disengaged.

During movement within the shift passageways in the selection direction, i.e. in the clearance area, this movement is tracked by a position sensor.

The detected passageway change in the selection direction is subsequently compared with the control parameters for controlling the selector fork in the selection direction. If this comparison shows that the position sensor does not indicate passageway changes in the selection direction that would have had to have been indicated in accordance with the control process, it is subsequently established that the position sensor of the selection motor and/or the selection motor itself is experiencing a functional impairment. Afterwards, the value indicated by the position sensor can be adapted.

The object is further attained with a method in accordance with claim 106.

The invented method allows the identity of an engaged gear to be checked. The invented method further or alternatively makes it possible to monitor existing gear identity information for accuracy.

In accordance with the invention, a signal is produced, which serves to ensure that the starting clutch of a motor vehicle is in an engaged state. To this end, the invention provides a feature for controlling the starting clutch such that it is in an engaged, gripping state. The identity of the engaged gear is then determined, based upon the number of revolutions that exist on different sides of the starting clutch, i.e. especially the engine speed and the speed of one wheel. Based upon a predetermined characteristic value, it is now determined which gear is engaged when those speeds exist and/or this speed ratio exists.

In accordance with a particularly preferred embodiment of the invention, an invented method is initiated when predetermined conditions, such as sensor problems, contradictory position data etc., are detected. This is the case particularly when a stop is detected, which, based on the detected position data, should not actually occur there.

In a preferred embodiment, the invented method is used in a motor vehicle with a clutch device that can be actuated by a hydraulic release system. This hydraulic release system has a volume control device, wherein the invented method is applied at least some of the time when a volume control process is performed.

In a particularly preferred embodiment, this invented method is used for adapting position and/or gear identity information, which is determined based upon a position sensor that follows the selector fork movement.

In a preferred embodiment, the selector fork is moved in the shift direction up to the final stop, which faces away from the selection passageway. This serves to ensure that a gear is engaged. Furthermore, the final stop can be used to reinitialize the passageway measuring process and/or the position sensor.

The object is further attained with a method in accordance with claim 111.

In accordance with the invention, a method for controlling a shift mechanism is provided, with which the identity of an engaged gear can be determined, and/or which is suited for examining information with regard to an engaged gear.

In accordance with the invention, the selector fork is moved in the direction of a predetermined final gear position. For this a target position is specified. During the engagement of a gear, an actual position of the selector fork and/or the selector and/or the shift motor is detected. Due to elastic forces in the transmission passageway, the actual position of the selector fork can not agree with the actual position determined by the position sensor. The deviation in the position between target value and actual value is determined, wherein the supply of current to the selection motor is also monitored. The identity of the controlled gear and/or the gear identity produced and/or assigned by a characteristic assignment value is recognized as being engaged when the following conditions have been met: on one hand the deviation in the position between target value and actual value is below a predetermined limit; on the other hand, the target position in the selection direction has been reached within a predetermined first period of time and/or the selection motor experiences a shut-off hysteresis upon reaching the target position for at least a predetermined period of time.

In accordance with a particularly preferred embodiment of the invention, the predetermined limit largely corresponds to the passageway width of the shift passageway that is assigned to the gear to be engaged.

In familiar configurations, cases can arise due to component elastic forces, in which the position sensor indicates a selector fork position that is located outside the

shift passageway in which the selector fork is currently situated. In extreme cases the position sensor can generate a selector fork position that corresponds to a different shift passageway from the one in which the selector fork is actually located. The invention makes it possible to avoid those disadvantages.

The patent claims that have been submitted with the application are formulation suggestions, without precedence for the purpose of obtaining broader patent protection. The applicant reserves the right to claim additional features, which have so far only been revealed in the description and/or drawings.

References employed in the sub-claims point to a further expansion of the object of the main claim through the features of the respective sub-claims; they should not be understood as a waiver of obtaining independent protection of the object for the features of the sub-claims to which reference is made.

The objects of those sub-claims however also represent autonomous inventions, which exhibit a design that is independent from the objects of the previous sub-claims.

The invention is not limited to the example(s) in the description. Within the framework of the invention rather numerous alterations and modifications are possible, in particular such variations, elements, combinations, and/or materials which have inventive character, especially via the combination or modification of individual features and/or elements or procedural steps in connection with those described in the general description and embodiments, as well as in the claims and those contained in the drawings, and which lead to a new object or to new procedural steps and/or procedural step sequences through features that can be combined, and to the extent that they relate to manufacturing, testing, and processing methods.

It should be pointed out that the interaction of the individual features of the invention is preferred in any random combination. In addition, combinations of characteristic features that are revealed by the independent claims while eliminating one or more characteristic features are preferred. The invented methods are also preferred in combination.

Furthermore, it should be noted that the embodiments for all known configurations, which do not relate to certain publications, are primarily known to the

applicant and/or inventor, so that the inventor reserves the right to protect them to the extent that they are not known to the public.

It should be noted that when combining features with "or," this "or" should be understood on one hand as a mathematical "or" and on the other hand as an "or" that excludes the respective other possibility.

It should further be noted that the term 'control' and terms derived from this term should be understood in a broad sense in accordance with the invention. This term comprises in particular a controlling and/or regulation, in accordance with the DIN (German Industrial Standard).

For the expert it is obvious that, beyond the embodiments of the invention that are presented here, a multitude of additional modifications and embodiments are feasible, which are covered by the invention. The invention is not limited to the embodiments shown here.

The invention will now be described in greater detail based on examples of embodiments, which do not limit the invention.

They show:

Fig. 1 a first exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 2 a second exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 3 a third exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 4 a fourth exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 5 a fifth exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 6 a sixth exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 7 a seventh exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 8 an eighth exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 9 a ninth exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 10 a tenth exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 11 an eleventh exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 12 a twelfth exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 13 a 13th exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 14 a 14th exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 15 a 15th exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 16 a 16th exemplary embodiment of the invention in a diagrammatic partial view;

Fig. 1 shows a diagrammatic view of a vehicle 1 with a drive unit 2, such as a motor or internal combustion engine. Further, a torque transmission system 3 and a transmission 4 are shown in the drive train of the vehicle. In this exemplary embodiment, the torque transmission system 3 is positioned in the flow of power between the motor and the transmission, wherein the driving torque of the motor is transmitted via the torque transmission system to the transmission, and from the transmission 4 on the driven side to a driven shaft 5 and a subsequent axle 6 and the wheels 6a.

A motor vehicle in accordance with Fig. 1 preferably contains a transmission system and/or control device in accordance with the invention, especially in accordance with one of the claims.

It is also preferred that in a motor vehicle 1 a method in accordance with the invention, especially an invented method in accordance with at least one claim, can be implemented.

The torque transmission system 3 is designed as a clutch, such as a friction clutch, a multi-disk clutch, a magnetic powder clutch, or a converter-bridging clutch, wherein the clutch can be a self-aligning or a wear-compensating clutch. The transmission 4 is depicted as a manual transmission, such as speed-changing transmission. In a preferred embodiment the transmission is designed as an automatic transmission, which can be automatically shifted via at least one actuating device. An automatic transmission should furthermore be understood as an automatic transmission that is shifted via a tractive force interruption, and in which the shifting process for the gear ratio is implemented via at least one actuating device, in a controlled manner.

Furthermore, an automatic transmission can also be used, in which an automatic transmission refers basically to a transmission without tractive force interruption in the shifting processes, which as a rule is constructed with planetary gear stages.

A continuously variable transmission, such as a taper disk belt-wrap transmission, can also be used. Furthermore, the automatic transmission can be equipped with a torque transmission system 3, such as a clutch or a friction clutch, which is positioned on the driven side. The torque transmission system can also be designed with a starting clutch and/or reversing gear clutch for reversing the direction of rotation, and/or as a safety clutch with a torque that can be transmitted and controlled in a controlled manner. The torque transmission system can be a dry friction clutch or a wet running friction clutch, which runs in a fluid. It can also be a torque converter.

The torque transmission system 3 comprises a drive side 7 and a driven side 8, wherein torque is transmitted from the drive side 7 to the driven side 8 by force that is supplied to the clutch disk 3a through the pressure plate 3b, the disk spring 3c, and the release bearing 3e, and through the flywheel 3d. For the purpose of supplying

this force, the release lever 20 is actuated via an actuating device, such as an actuator.

The torque transmission system 3 is controlled via a control unit 13, such as a control device, which can comprise the control electronics 13a and the actuator 13b. In another beneficial embodiment, the actuator and the control electronics can also be arranged in two different components, such as housings.

The control unit 13 can contain the control and power electronics for controlling the electric motor 12 of the actuator 13b. This can be advantageously accomplished due to the fact that the only space the system requires is the space for the actuator with the electronics. The actuator consists of a driving motor 12, such as an electric motor, wherein the electric motor 12 influences a master cylinder 11 via a transmission, such as worm gear, spur pinion gear, crank gear, or a threaded spindle transmission. This influence on the master cylinder can occur directly or through rods.

The movement of the starting part of the actuator, such as the master cylinder piston 11a, is detected via a clutch passageway sensor 14, which detects the position or location or speed or acceleration of a variable proportional to the position and/or engaging position, or the speed or acceleration of the clutch. The master cylinder 11 is connected to the slave cylinder 10 via a pressure fluid pipe 9, such as a hydraulic fluid pipe. The starting element 10a of the slave cylinder is actively connected to the release lever or release 20 so that a movement of the starting component 10a of the slave cylinder 10 causes the release 20 to be moved or tilted so as to control the torque transmitted from the clutch 3.

To control the transmittable torque of the torque transmission system 3, the actuator 13b can be actuated via pressure, i.e. it can be equipped with pressure-controlled master and slave cylinders. The source of pressure can comprise, especially, a hydraulic fluid or a pneumatic medium. The pressure-controlled master cylinder can be actuated via an electric motor, wherein the electric motor 12 can be controlled electronically. The driving element of the actuator 13b can also be another preferably pressure-controlled driving element, in addition to the driving element with

the electric motor. Furthermore, magnetic actuators can be used in order to adjust the position of an element.

In the case of a friction clutch, transmittable torque is controlled by pressing the friction lining of the clutch disk between the flywheel 3d and the pressure plate 3b, in a controlled manner. The position of the release mechanism 20, such as a clutch release fork or central release device, allows the force that is supplied to the pressure plate and friction lining to be controlled; the pressure plate can then be moved between two final positions, and can be randomly adjusted and fixed. One end position corresponds to a completely engaged clutch position and the other end position to a completely disengaged clutch position. To control transmittable torque, which is lower than the engine torque that is available at any given time, a position of the pressure plate 3b, which lies in an intermediate area between the two end positions, can be controlled. The clutch can be fixed in this position via the controlled selection of the release mechanism 20. However, transmittable clutch torque that is higher than the engine torque that is available at any given time can also be controlled. In such a case, the available engine torque can be transmitted, wherein the torque irregularities in the drive train, especially in the form of torque peaks, are dampened and/or insulated.

For purposes of controlling and regulating the torque transmission system, sensors are also employed, which monitor the relevant variables of the entire system at least part of the time, and provide the condition variables, signals, and measuring values that are required for control purposes and are processed by the control unit; in this, a signal connection to other electronic units, including especially engine electronics or an electronic system of an anti-lock braking system (ABS) or an anti-slip control (ASR) system, can be provided and can exist. The sensors detect especially speeds, such as wheel speed and engine speed, the position of the load lever, the throttle valve position, the gear position of the transmission, intended shifting, and other vehicle-specific parameters.

In the arrangement in Fig. 1, a throttle valve sensor 15, an engine speed sensor 16, and a speedometer sensor 17 are being used, with forward measurement values and/or information being forwarded to the control device. The electronic unit,

such as a computer unit, in the control unit 13a processes the system input variables and passes control signals on to the actuator 13b.

The transmission is designed as a speed-changing transmission, wherein the transmission ratios are changed via a shifting lever, or the transmission is actuated or operated via this shifting lever. Furthermore, a sensor 19b, which detects the shifting intention and/or the gear position and forwards this information to the control unit, is positioned on the operating lever, such as the shifting lever 18, of the manual transmission. The sensor 19a is connected to the transmission and detects the current gear position and/or a shifting intention. The shifting intention can be recognized by utilizing at least one of the two sensors 19a, 19b in that the sensor is designed as a force sensor, which detects the force that is applied to the shifting lever. Furthermore, the sensor can also be a passageway or position sensor, wherein the control unit recognizes a shifting intention from the time change of the position signal.

The control device maintains a signal connection with all sensors at least part of the time, and evaluates the sensor signals and system input variables in such a way that, based upon the current operating point, the control unit issues controlling or regulating instructions to the at least one actuator. The driving element 12 of the actuator, such as the electric motor, receives a manipulated variable from the control unit, which controls clutch actuation, based upon measurement values and/or system input variables and/or signals from the connected sensor system. To this end, a control program is implemented in the control device as hardware and/or software, which evaluates the incoming signals and calculates or determines the starting variables based on comparisons and/or functions and/or performance characteristics.

The control device 13 beneficially contains a torque-determining unit, a gear position determining unit, a slippage detection unit, and/or an operating mode-determining unit, or has a signal connection with at least one of those units. Those units can be implemented as hardware and/or software via control programs, so that with the incoming sensor signals the torque of the driving unit 2 of the vehicle 1, the gear position of the transmission 4, the slippage that exists in the area of the torque transmission system, and the current operating mode of the vehicle can be

determined. The gear position determining unit establishes the currently engaged gear based on signals from the sensors 19a and 19b. The sensors are connected to the shifting lever and/or the internal transmission corrector, such as a central selector shaft or sliding selector shaft, and they serve to detect especially the position and/or the speed of those components. Furthermore, a load lever sensor 31 can be arranged on the load lever 30, such as a gas pedal, which detects the position of the load lever. Another sensor 32 can act as an idle switch 32, which is switched on via an actuated gas pedal, such as a load lever, and is switched off via a non-actuated signal, so that this digital information allows a determination as to whether the load lever, such as the gas pedal, is actuated. The load lever sensor 31 detects the degree of actuation of the load lever.

In addition to the gas pedal 30, as the load lever, and the sensors that are connected to it, Fig. 1 also depicts a brake application element 40 for actuating the service brake or parking brake, which can comprise a brake pedal, a hand brake lever or a hand- or foot-actuated element of the parking brake. At least one sensor 41 is arranged on the application element 40 and monitors its actuation. The sensor 41 is designed in particular as a digital sensor, such as a switch, which detects whether or not the application element has been actuated. This sensor can have a signal connection with a signal device, such as a brake light, which indicates that the brake has been actuated. This can include both the service brake and the parking brake. The sensor, however, can also be designed as an analog sensor, with such a sensor, especially a potentiometer, determining the degree of actuation of the application element. This sensor can also stand in signal connection with a signal device.

Fig. 2 depicts a diagrammatic view of a drive train of a motor vehicle comprising a drive unit 100, a torque transmission system 102, a transmission 103, a differential 104 as well as driving shafts 109 and wheels 106. The torque transmission system 102 is arranged on or fastened to a flywheel 102a, wherein the flywheel generally contains a starting gear rim 102b. The torque transmission system has a pressure plate 102d, a clutch cover plate 102e, a disk spring 102f, and a clutch disk 102c with friction lining. The clutch disk 102c, which can comprise a damping

device, is arranged between the clutch disk 102d (sic) and the flywheel 102a. A power reservoir, such as a disk spring 102f, supplies the pressure plate with power in an axial direction toward the clutch disk, wherein a release bearing 109, especially a pressure-actuated central release device, is provided for actuating the torque transmission system. A release bearing 110 is arranged between the central release device and the disk spring tongues of the disk spring 102f. Axial movement of the release bearing supplies power to the disk spring and releases the clutch. The clutch can also be designed as a pressed or pulled clutch.

The actuator 108 is an actuator of an automatic transmission, which also contains the actuating device for the torque transmission system. The actuator 108 actuates transmission-internal shifting elements, such as a drum controller or sliding selector shaft or a central selector shaft of the transmission, wherein upon actuation the gears can be engaged or disengaged sequentially or in any random sequence. The clutch application element 109 is actuated via the connection 111. The control unit 107 is connected to the actuator via a signal connection, with the signal connections 113 through 115 being connected to the control unit; the line 114 processes incoming signals, the line 113 processes control signals from the control unit, and the connector 115 establishes a connection with other electronic units via a data bus.

In order to start the vehicle basically from an idle position or a slow rolling motion, such as a creeping motion, i.e. for a controlled acceleration of the vehicle that is initiated by the driver, the driver actuates only the gas pedal, such as the load lever 30, wherein the controlled or regulated automatic clutch actuation controls the torque to be transmitted by the torque transmission system through the actuator during a starting process. By actuating the load lever, the load lever sensor 31 detects the driver's desire for a more or less strong or fast starting process, and controls the control unit accordingly. The gas pedal and its sensor signals are used as input values for controlling the starting process of the vehicle.

In a starting process, the torque that is to be transmitted, such as the clutch torque $T_{CTarget}$, is basically determined via a specifiable function, or based upon characteristic lines or characteristic fields while putting the vehicle in motion

especially based upon the engine speed, wherein dependency on the engine speed or on other values, such as engine torque, is beneficially realized through a characteristic field or a characteristic line.

If during the process of starting from an idle position or from a slow creeping condition, the load lever and/or the gas pedal is actuated at low speed to a predetermined value a, then the engine torque is controlled via an engine control unit 40. The control unit of the automatic clutch actuator 13 controls specifiable functions or characteristic fields accordingly via the torque to be transmitted by the torque transmission system, so that a stationary state of equilibrium is created between the controlled engine torque and the clutch torque. The state of equilibrium is characterized based upon the load lever position *a* by a predetermined starting speed, a starting or engine torque, a predetermined transmittable torque from the torque transmission system, and a torque that is transmitted to the driving wheels, such as a driving torque. The functional connection of the driving torque as a function of the starting speed is referred to below as the starting characteristic. The load lever position *a* is proportional to the position of the throttle valve of the engine.

In addition to the gas pedal 122, as a load lever, and a sensor 123 that is connected to it, Fig. 2 also depicts a brake application element 120 for actuating the service brake or the parking brake, such as a brake pedal, a manual brake lever, or a hand- or foot-actuated element for applying the parking brake. At least one sensor 121 is connected to the application element 120 and monitors its actuation. The sensor 121 is designed specifically as a digital sensor, such as a switch, which detects whether or not the application element is actuated. A signal device, such as a brake light, can stand in a signal connection with this sensor, to indicate whether or not the brake has been actuated. This can apply to both the service brake and the parking brake. The sensor, however, can also be designed as an analog sensor, wherein such a sensor, especially a potentiometer, determines the degree of actuation of the application element. This sensor can also have a signal connection with a signal device.

Fig. 3 shows a selection-shift-passageway device that is contained in a shift mechanism of a transmission system and has shift passageways 310, 312, 314, 316,

318, 320, as well as a selection passageway 322. Fig. 3 further shows a pattern that is projected into this selection-shift-passageway device, with this pattern containing a first area 324 and a second area 326. The first area 324 is assigned a first digital signal from the sensor field, while the second area 326 is assigned a second digital signal from the sensor field.

A selector fork, which is not shown here and is moved especially from position 328 toward the passageway wall 332, in the direction indicated by the arrow 330, is controlled in such a way that it strikes this passageway wall, which is detected in accordance with a predetermined characteristic value, especially by monitoring a parameter or its course over time, especially such as engine tension or engine current. When this stop against the passageway wall 332 has been detected, the selector fork is moved back in the direction of the arrow 334 toward the selection passageway 322. At the position 336 the selector fork, which by then has moved into a second area 326, meets a first area 324 of the pattern. The digital change associated with this makes it possible to detect and/or detect an absolute position in the shift direction. This absolute position can be used in aligning, for example, an incremental position sensor. The selector fork is then moved in the direction of the arrow 338, wherein at the location and/or the selector fork position 340 another boundary between the second area 326 and the first area 324 is encountered, and is registered as a digital change by the sensor device, which is not shown here and which scans the sensor field. This digital change enables the detection of an absolute position in the selection direction.

In the example of a selector fork controlling process, within three movement processes both an absolute position in the shift direction and an absolute position in the selection direction were detected, both of which can be used in aligning a position sensor.

It should be noted that the position of the selector fork in the position 328 can be left unknown in accordance with the invention. If the selector fork had been in another unknown position, such as the selector fork position 342, then the absolute position in the shift direction and in the selection direction would have already been detected following two movement processes. It should be noted that in such a case

movement in the direction of the arrow 338 would have been symmetrical to the axis of the selection passageway.

Fig. 4 shows a fourth exemplary illustration of the invention in a diagrammatic, partial view.

Specifically, a selection-shift-passageway device with shift passageways 310, 312, 314, 316, 318, 320 and a selection passageway 322 is also shown in Fig. 4.

Within this selection-shift-passageway device, a pattern that has been projected in accordance with a sensor field is shown; this pattern contains first areas 350, 352, 354, 356 and second areas 358, 360, 362, 364, 366.

The first areas 350, 352, 354, 356 are assigned a first digital signal, while the second areas of the pattern 358, 360, 362, 364, 366 are assigned a second digital signal. When moving from the second area 366 into the first area 350 or vice versa, a digital change, which can be used to align the shift passageway position, can be detected at the contact line 368. Accordingly, an absolute position in the shift direction can also be detected at the contact line 370 between the first area 350 and the second area 364 and/or at the contact line 372 between the first area 354 and the second area 362 and/or at the contact line 374 between the second area 362 and the first area 352 and/or at the contact line 376 between the second area 360 and the first area 356 and/or at the contact line 378 between the first area 356 and the second area 358. It should be noted that such traveling movements in both directions of shifting could be considered as travel movements. The direction and orientation of travel are taken into consideration when determining the absolute position.

In the selection position, an absolute position can be detected especially at the contact lines 380, 382, 384, 386, 388, 390, i.e. at the transition points between the second area 366 and the first area 354 and/or the first area 350 and the second area 362 and/or between the second area 364 and the first area 352 and/or the transition between the first area 354 and the second area 360 and/or the transition between the second area 362 and the first area 356 and/or the transition between the first area 352 and the second area 358.

Here as well directions of travel, especially in the direction of the selection passageway 322, can be taken into consideration. It is also preferred that traversing movements in the selection direction are executed at a preferably small angle relative to the selection direction.

Fig. 5 shows a fifth exemplary embodiment of the invention in a diagrammatic, partial view.

Fig. 5 shows a selection-shift-passageway device with a digital pattern that is projected into the device. The first area 400, 402, 404, 406 is basically designed in a cross shape, while the overlapping area of the crossing partial areas is designed as a second area 408. The first area 402 and/or 404 extends into the shift passageway 310 and/or 312 so that it interrupts the first area 410, 412 and/or the first area 414, 416 and/or borders it.

Fig. 6 shows a sixth exemplary embodiment of the invention in a diagrammatic, partial view.

Specifically, Fig. 6 depicts another exemplary embodiment of a pattern that is projected onto a selection-shift-passageway device.

This pattern, which corresponds to the transformation of a digital signal area, contains a first area 430, 432, which is assigned a first digital signal, and a second area 434, 436, 438, 440, 442, 444, 446, which is assigned a second digital signal that differs from the first digital signal.

The first area 430, 432 extends basically in a longitudinal direction along the selection passageway 322, and is interrupted by a second area 438 in a location, which here is situated in the selection direction between two shift passageways.

The first area extends across the entire width of the selection passageway 22 and beyond that into the shift passageways 310, 312, 314, 316, 318, 320 in the selection direction.

When crossing over from the first area 430 into the second area 438 or vice versa, and/or when crossing over from the first area 432 into the second area 438 or vice versa, an absolute position in the selection direction can be determined based on the digital change that occurs.

Accordingly, when crossing over from the second area 440 and/or 422 and/or 444 and/or 446 into the first area 430 or vice versa, an absolute position in the shift direction can also be determined; the same is true for a crossover from the second area 434 and/or 436 into the first area 432 or vice versa.

Fig. 7 shows a seventh exemplary embodiment of the invention in a diagrammatic, partial view.

Specifically, Fig. 7 depicts another example of a pattern that is projected into a selection-shift-passageway device, which corresponds to a digital signal area.

The digital signal area is located on the selector shaft, which is not illustrated here.

The first area and/or its partial areas 450, 452, 454 represent a first digital signal, which causes a sensor device to start when the signal area is scanned and/or when the fork, which is not shown here, is located in this area.

Accordingly, the partial areas of the second area 456, 458, 460, 462, 464 produce a second digital signal, which differs from the first one, when the sensor device, which is not shown here, scans the signal area in areas that correspond to those areas and/or when the selector fork is located in those areas.

The first area 450, 452, 454 consists of a partial area 450, which is aligned in the selection direction, and a partial area 452, 454, which is aligned in the shift direction, wherein the overlapping area of those partial areas 450, 452, 454 represents a second area 464.

In addition to the fact that, in the area of overlap, the partial areas 450, 452, 454 of the first area form a second area 464, the first area is T-shaped in this exemplary embodiment of the pattern.

When the selector fork, which is not shown, reaches the contact lines 464, 468, 470, 472, 474, 476 and/or crosses over them, and/or when the sensor device, which is not shown here, detects a digital change when scanning the sensor field, an absolute position in the shift direction can be determined, especially if the travel direction of the selector fork and/or its orientation are taken into consideration.

Accordingly, when moving in the selection direction, an absolute position in the selection direction can be determined at the contact line 478 and/or the associated digital change.

Fig. 8 depicts a selection-shift-passageway device, into which a pattern that corresponds to a digital sensor field is projected.

This pattern contains a first area 490, 492, 494, 496, which is basically cross-shaped and is oriented in the selection direction as well as in the shift direction, and which is assigned a first digital signal.

Accordingly, the pattern has a second area 498, 500, 502, 504, 506, to which a second digital signal is assigned.

The overlapping area of the cross-shaped first area 490, 492, 494, 496 is designed as a second area 502.

The partial areas 492, 494 of the first area that extend in the shift direction are arranged in such a way that they extend into two adjacent shift passageways 310, 314 and/or 312, 316, respectively. In doing so, however, they cover only a partial area of those passageways 310, 312, 314, 316, while another partial area is covered by a second area 498, 500, 504, 506.

A digital change is detected at the contact lines 508, 510, 512, 514, 516, 518 during a travel movement, which has at least one component in the shift direction. Upon detecting this digital change, an absolute position of the selector fork in the shift direction can be established, especially when the direction and orientation of the travel movement are taken into consideration.

Accordingly, an absolute position in the selection direction can be detected at the contact lines 520, 522, 524, 526, 528, 530.

Fig. 9 depicts a selector shaft 540 in a partial view with a first indentation 542 and a second indentation 544. The depth of the first indentation 542 is less than the depth of the second indentation 544, so that those indentations 542, 544 have different potential with regard to the central axis 546 of the selector shaft 540. In the axial direction of the selector shaft 540 an area 548 is located between the indentations 542 and 544; this area has a third potential with regard to the central

axis 546 and otherwise corresponds to the "regular" outer circumference of the selector shaft 540.

When the selector shaft 540 is moved in an axial direction in order to actuate a transmission system, which is not shown here, the stationary sensor device 550 scans the outer surface of the selector shaft 540 and rests in predetermined shifting positions in the area 548 and/or in the area 542 and/or in the area 544. Depending upon the associated penetration depth, the transmission positions that exist when the sensor device 550 is arranged in the indentation 542 and/or the indentation 544 can be differentiated from other transmission positions.

The first indentation 542 corresponds to the "neutral" transmission position, while the transmission position in which the sensor device 550 rests in the second indentation 544 corresponds to the "reverse" transmission position.

Fig. 10 depicts a selector shaft 540 with a profile. The profile of the selector shaft 540 has surface elevations 560, 562 as well as surface indentations 564, 566, 568.

To actuate the transmission system, which is not shown here, the selector shaft can be moved axially in the direction of the double arrow 570, and can articulate and/or swivel in the direction of the double arrow 572 around the central axis of the selector shaft.

The retainer 576 that is seated in the transmission case 574 has a spring-loaded ball 578, which rests against the surface profile of the selector shaft 540. When the selector shaft 540 is moved, the ball 578 moves along the surface profile of the selector shaft 540. The profile causes the ball to execute a translatory movement in the direction of the retainer axis.

In transmission positions in which the ball 578 rests in the surface indentations 564, 566, 568 of the selector shaft, the transmission system takes on predetermined shifting positions, and/or a selector fork, which is not shown here, takes on predetermined positions within a selection-shift-passageway device.

Specifically, three surface indentations 564 are arranged on the outer circumference of the selector shaft with equal axial locations, wherein the

transmission system is in the end positions of the first and/or the third and/or the fifth gears when the ball 578 rests in the surface indentations 564.

Accordingly the transmission assumes a neutral position when the ball 578 is located in the surface indentation 566.

The transmission system accordingly assumes the end positions of the second, the fourth, and/or the reverse gears when the ball 578 is located in one of the three surface indentations 568 of the selector shaft that are arranged on the circumference at equal axial positions.

The shifting notch device (retainer) shown in Fig. 10 preferably produces redundancy signals for the measured values and/or signals regarding the final gear position that have been produced by a position-sensing device.

In the retainer a sensor, which is not shown here, is positioned, which detects the different translatory positions of the ball 578 and/or which determines when the ball 578 is resting in the surface indentations 564, 566, 568.

Fig. 11 shows an example of a course of a signal, which can be produced by the retainer shown in Fig. 10 and/or by its sensor device.

Specifically, it shows the course of a signal of the redundancy sensor shown in Fig. 10 over the selector shaft position.

The signal 590 indicates that the transmission system is in the final gear position of the first or the third or the fifth gear.

The signal 592 indicates that the transmission system is in a neutral position.

The signal 594 indicates that the transmission is in the final gear position of the second, the fourth, or the reverse gears.

Fig. 12 shows a selection-shift-passageway device, which is used in accordance with the invention.

For purposes of clarity the following directional agreement shall be made. The arrow 600 resting in the shift direction points forward, while the arrow 602 oriented the opposite direction points backward. The arrow 604, aligned in the selection direction, points to the left, while the arrow 606, aligned opposite the arrow 604, points to the right.

At the front, the first, the third, and the fifth gears are arranged next to one another from left to right. At the back, the second, the fourth, and the reverse gears are arranged next to one another from left to right. The neutral position is basically in the middle.

It should be noted that the reverse gear is preferably arranged not – as shown here – diametrically opposite, outside of the first gear, but to the left of the first gear.

Fig. 13 shows a 13th exemplary embodiment of the invention in a diagrammatic, partial view.

If the necessity of neutral reference movement has been established, i.e. when it is determined during driving that with a disengaged clutch the engine speed and vehicle speed are not in agreement with the gear that is supposed to be engaged, for example, then neutral reference movement is initiated in step 610. If it is then determined that the vehicle condition is not dangerous, i.e. when it has been established that neutral reference movement will not result in any damage, particularly to the transmission, and/or preferably when the vehicle is standing still, then in step 612 a tactile process toward the left is initiated, followed by a tactile process toward the right. If the width, i.e. the maximum distance between the left point that has been determined in this way and the right point that has been determined in this way, is greater than a predetermined width, it can be deduced that the selector fork is located in the selection passageway. Since the LR tactile process concludes with a tactile process to the right, in step 614 it can be determined whether or not the neutral gear is engaged on the right end.

If, however, it is found following the LR tactile process that the determined width is smaller than a predetermined width, then in step 616 a F-tactile process is initiated, with simultaneous R-pressing. If no stop is detected via this process, or if a pressing to the right is successful, i.e. movement to the right is detected, then a RLR tactile process is initiated in step 618. This RLR tactile process serves especially control purposes. If, during this RLR tactile process, the width and/or the distance that is detected between the farthest point to the left and the farthest point to the right exceeds a predetermined width, it can be deduced that the selector fork is located in the selection passageway. It can further be concluded that a lower gear was

engaged prior to that point. Since the RLR tactile process concludes with a tactile process to the right, in step 614 it can be determined whether or not the right end of the neutral gear is engaged.

In cases in which it has been found via step 616 that a stop has been detected, and/or in cases in which it can be concluded that a stop has been detected, which here would mean that an upper gear is engaged, and/or when it can be established via step 618 that the detected width is smaller than a predetermined width, i.e. the selector fork is located in a shift passageway, then an R-tactile process with a simultaneous L-pressing process is initiated in step 620. If no stop is detected, or if pressing to the left is successful, i.e. a traversing movement to the right is recognized, then a LR tactile process for control purposes is introduced in step 622.

If the distance between the left and the right points, and/or the width, that is detected exceeds a predetermined width, it can be concluded that the selector fork is located in the selection passageway; it can then be established in step 614 that the neutral gear is engaged at the right end.

Fig. 14 depicts a selection-shift-passageway device in which passageways of movement of the selector fork, which is not shown here, are clarified; those passageways of movement can be initiated especially for the purpose of detecting the neutral gear position and/or an absolute position in the shift direction within the framework of and/or in the presence of neutral reference movement.

Starting from an unknown selector fork position 630 in the shift direction, the selector fork, which is not shown here, is moved especially along the arrow 632 in the selection passageway 322 toward a passageway wall 634 located at the end of the selection passageway 322. When the selector fork reaches this passageway wall 634, which is detected via an indirect process, the selector fork is moved back in the opposite direction of the selection passageway, a predetermined distance along the arrow 636, in the selection direction. This predetermined distance is measured such that, at the end of this movement, the selector fork, oriented in the selection direction, is located basically at the center between the shift passageways 310 and 314 and/or 312 and 316. The selector fork is then moved in the shift direction, i.e. along the

arrow 640, up to an area of the longitudinal wall 642. This position can be used for alignment in the shift direction.

In order to prevent any sideways slippage, especially in the direction of the arrow 644 or in the direction of the arrow 646, into a shift passageway, i.e. especially into the shift passageway 312 or the shift passageway 326, the selection passageway position is monitored. If the selection passageway position does not remain the same during movement in the direction of the longitudinal wall 642, the danger of sideways slippage exists.

Fig. 15 depicts a selection-shift-passageway device.

The final gear positions 660, 662, 664, 666, 668, 670 are designed such that a selector fork, which is not shown here, can be arranged within them, allowing for clearance in the selection direction and in the shift direction.

When the gears are engaged, the selector fork is positioned in predetermined selector fork positions 672, 674, 676, 678, 680, 682, which are assigned to the respective gears, in accordance with a predetermined coding characteristic. Those positions differ in accordance with a predetermined characteristic value.

Especially in a final gear position 660, the selector fork is positioned at the rear in the center; in a final gear position 662 the selector fork is positioned at the front to the left; in a final gear position 664 the selector fork is positioned at the rear to the left; in a final gear position 666 the selector fork is positioned at the front in the center; in a final gear position 668 the selector fork is positioned to the rear at the right; in a final gear position 670 the selector fork is positioned at the top to the right. The directional information corresponds in particular to that of the arrow cross, wherein the arrow 684 represents the forward direction, the arrow 686 represents the rear direction, the arrow 688 represents the right direction, the arrow 690 represents the left direction, and the point 692 represents the center.

In order to decode the gear position information, the selector fork can be moved with traversing movements to the left and/or right, and to the front and/or rear, within the final gear positions so that, based upon the passageways of movement, a conclusion can be drawn about the engaged gear.

Fig. 16 depicts a shift passageway 700 and a selection passageway 702. The lines 704 and 706 represent two examples of passageways of movement, along which the selector fork, which is not shown here, can be displaced within the shift passageway 700 for the purpose of checking a selection motor or its position sensor. Those passageways 706, 708 are especially characterized in that the movement occurs not only in the shift direction; instead, it also contains a component in the selection direction within the shift passageway.

Monitoring the values indicated by the passageway-measuring device in the selection direction allows the functioning of the selection motor and/or its passageway-measuring device also to be monitored.

The point 710 represents an example of a selector fork position that is assumed by the selector fork with an engaged gear.

References employed in the sub-claims point to a further expansion of the object of the main claim through the features of the respective sub-claims; they should not be understood as a waiver for obtaining independent protection of the object for the combinations of features in the sub-claims to which reference is made.

Since the objects of the sub-claims can represent independent and autonomous inventions with regard to the state of the art on the priority date, the applicant reserves the right to make them the object of independent claims or partial declarations. Furthermore, they can contain independent inventions, which exhibit a design that is independent from the objects of the previous sub-claims.

The exemplary embodiments should not be understood as a limitation of the invention. Within the framework of the present disclosure, numerous alterations and modifications are possible, especially such variations, elements, and combinations and/or materials which can be deduced by experts in the field with regard to resolving the object, for example, via the combination or modification of individual features and/or elements or procedural steps in connection with those described in the claims and those contained in the drawings, and which lead to a new object or new procedural steps and/or procedural step sequences through features that can be combined, also to the extent that they relate to manufacturing, testing, and processing methods.